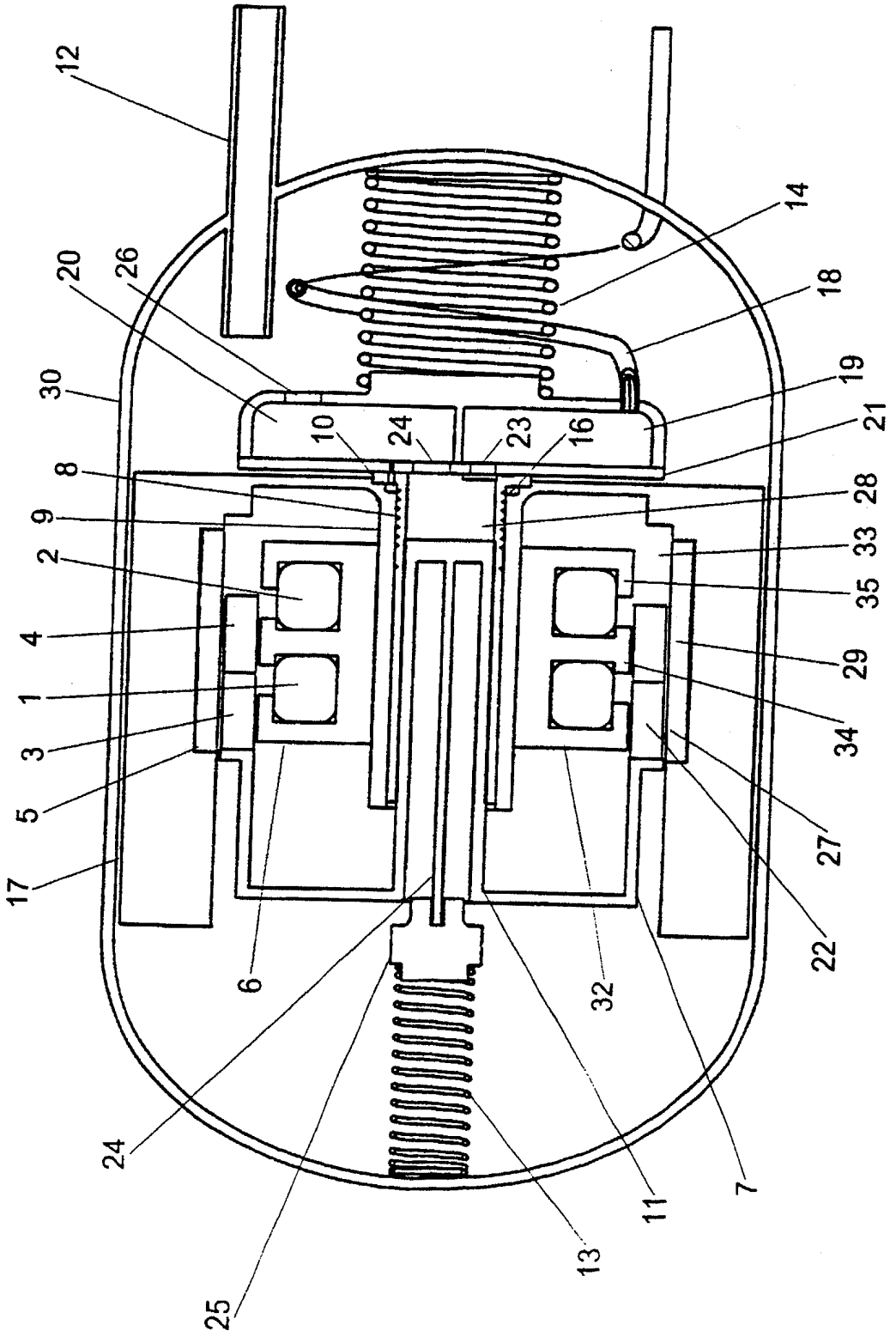

12
14
20
26
18
30
19
10
24
23
16
21
8
28
9
33
2
35
4
29
1
34
3
27
5
22
17
6
32
24
11
7
13
25

FIG. 1

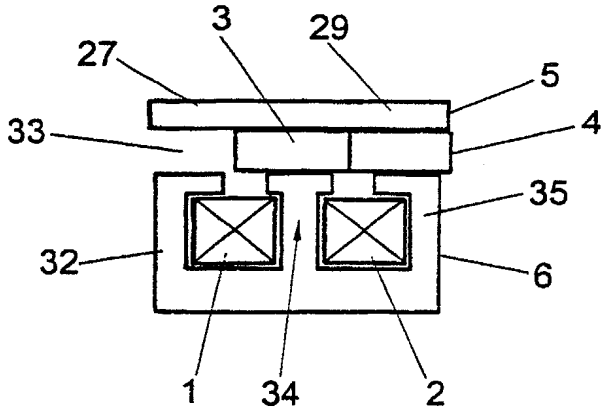


FIG. 2

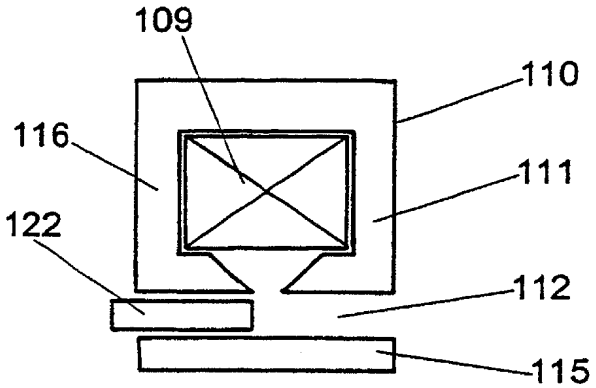


FIG. 3

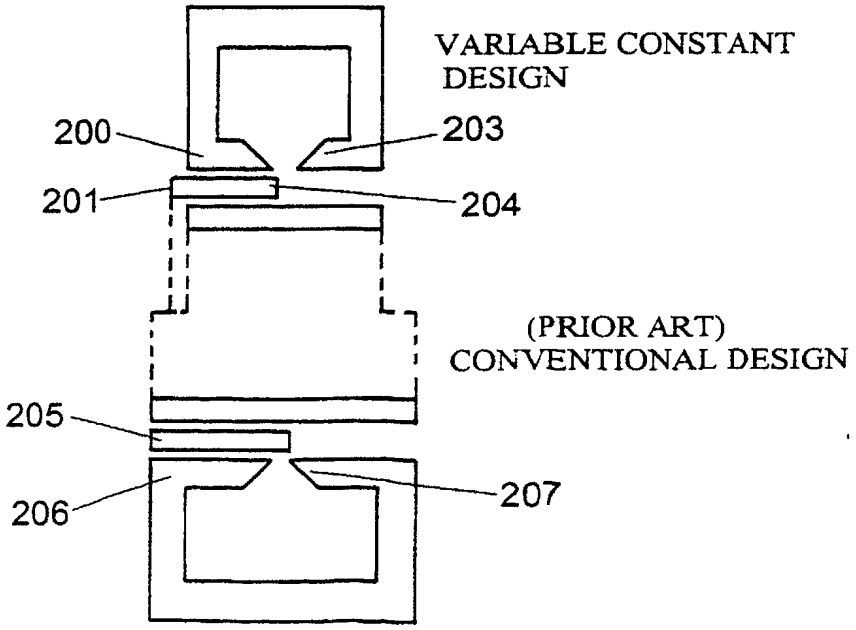


FIG. 4

FIG. 5

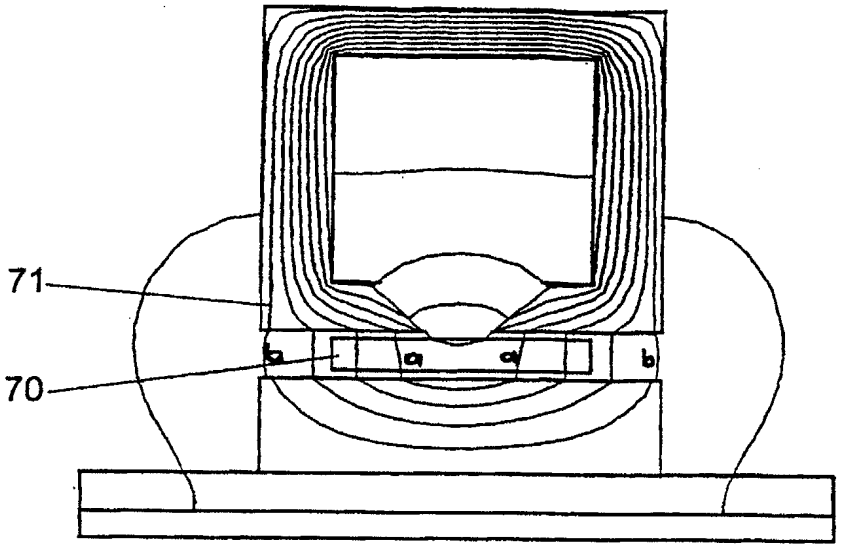
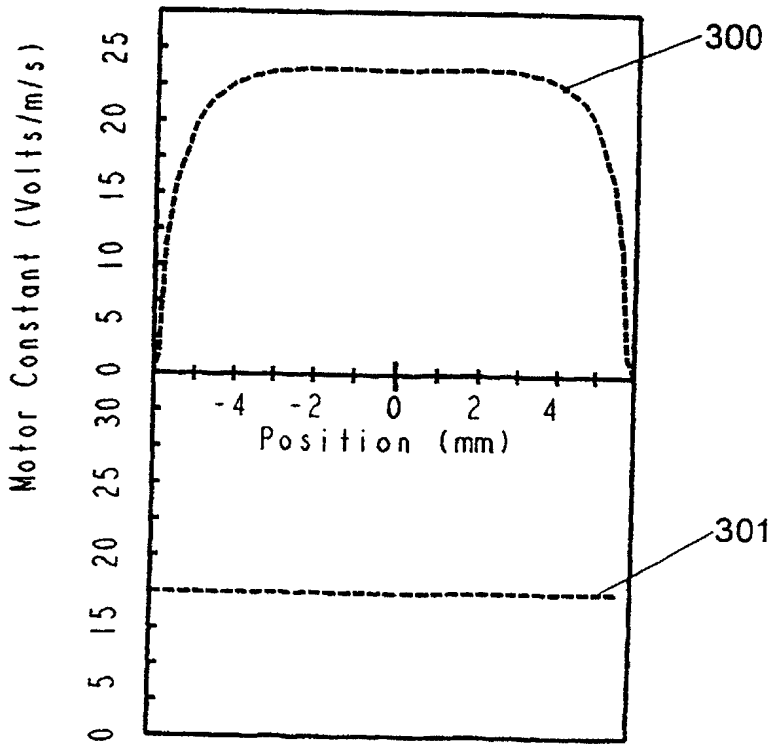

71
70
b
a
a
b

FIG. 6


Motor Constant (Volts/m/s)
0 5 15 20 25 30 25 20 15 10 5 0
-4 -2 0 2 4
Position (mm)
300
301

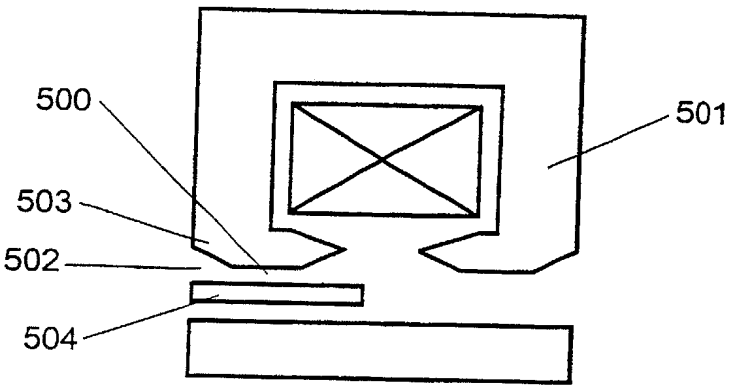


FIGURE 7

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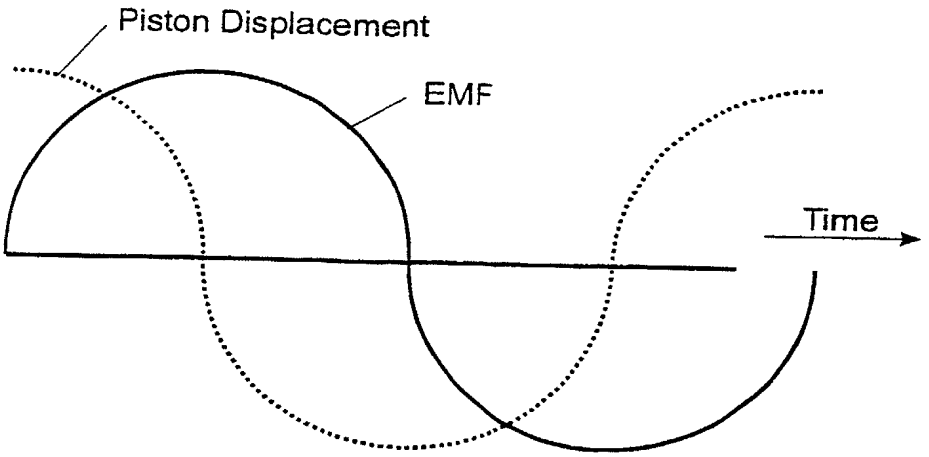

FIGURE 8a

Motor EMF and Displacement Waveforms

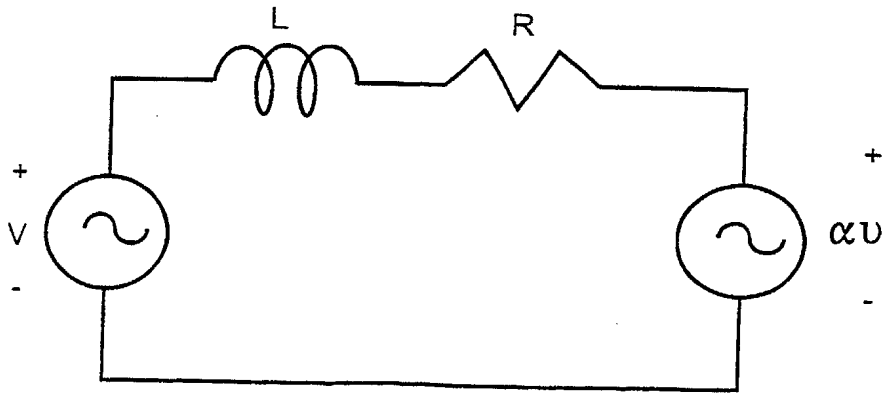

FIGURE 8b

Motor Equivalent Circuit

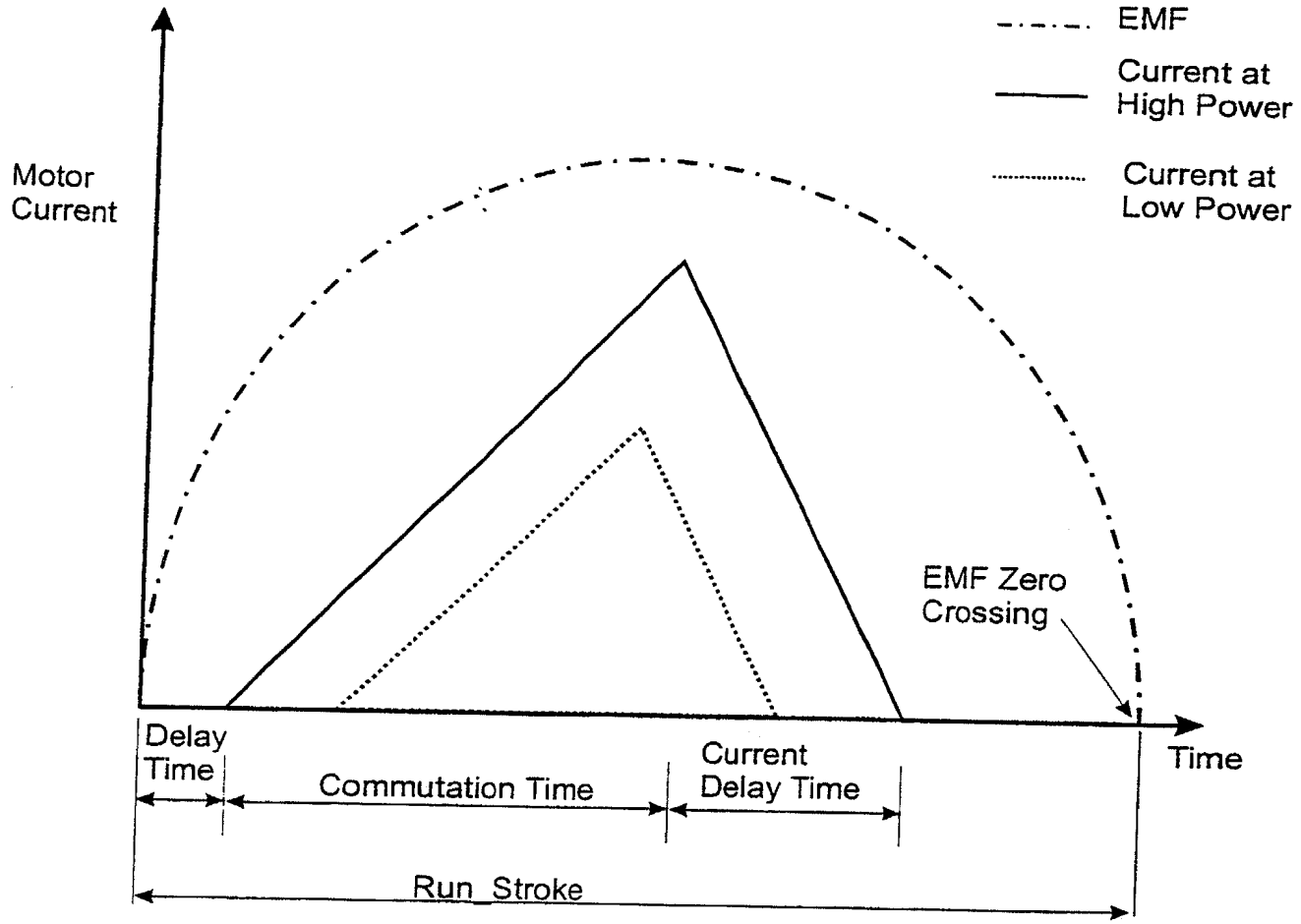

FIGURE 15
Motor Current Waveform and Timing

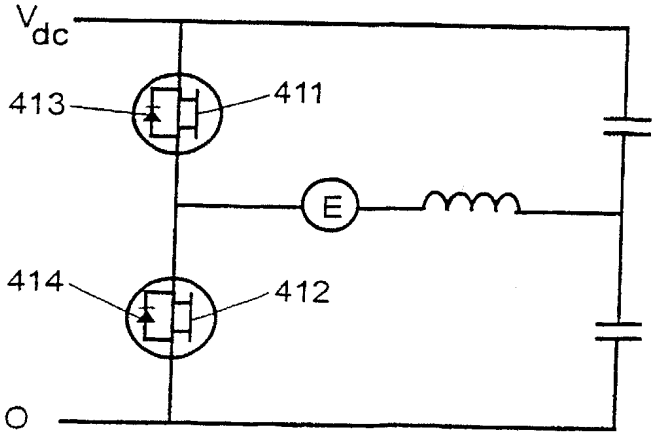

FIGURE 9

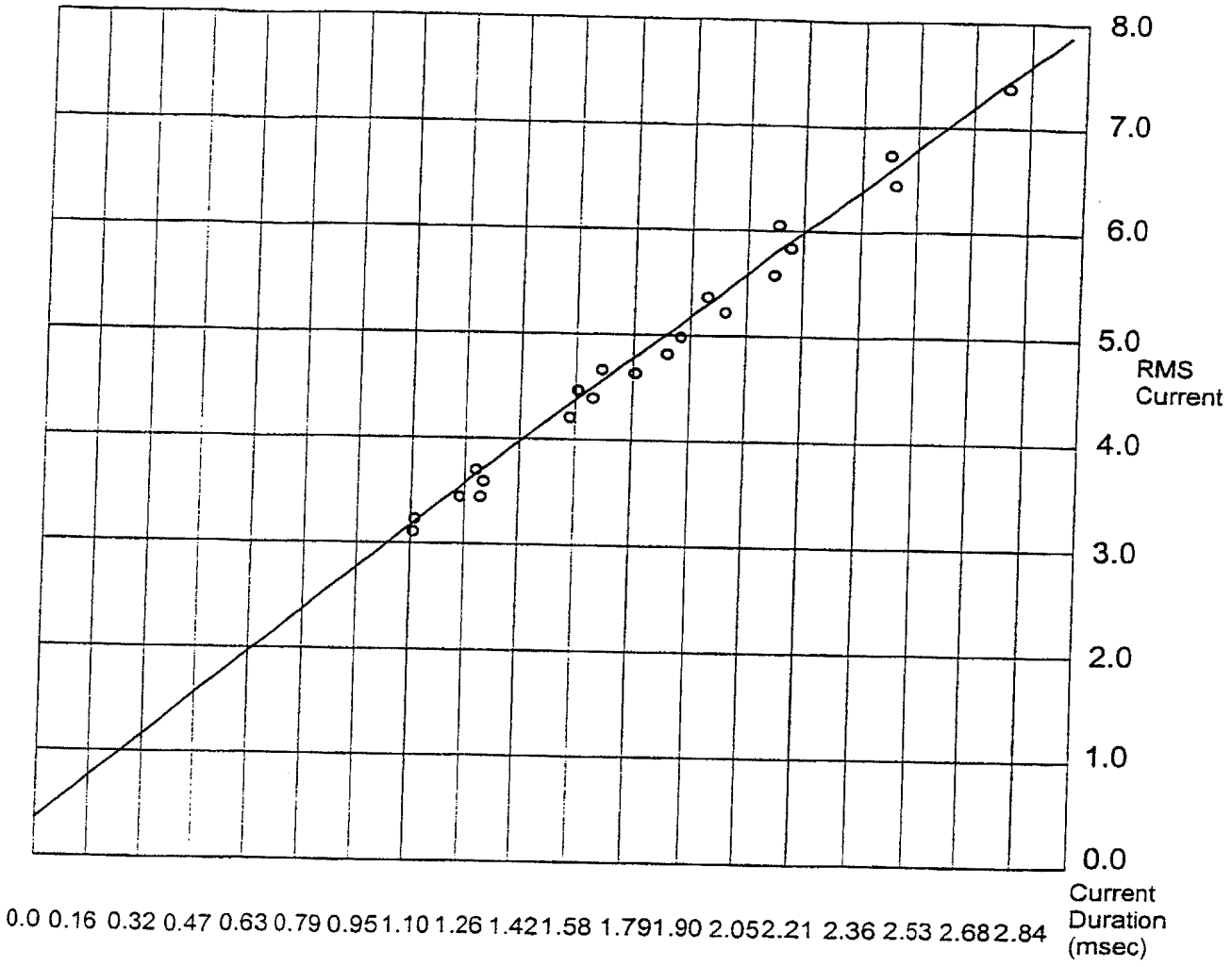
8.0
7.0
6.0
5.0
RMS
Current
4.0
3.0
2.0
1.0
0.0
0.0 0.16 0.32 0.47 0.63 0.79 0.95 1.10 1.26 1.42 1.58 1.79 1.90 2.05 2.21 2.36 2.53 2.68 2.84
Current
Duration
(msec)

FIGURE 12

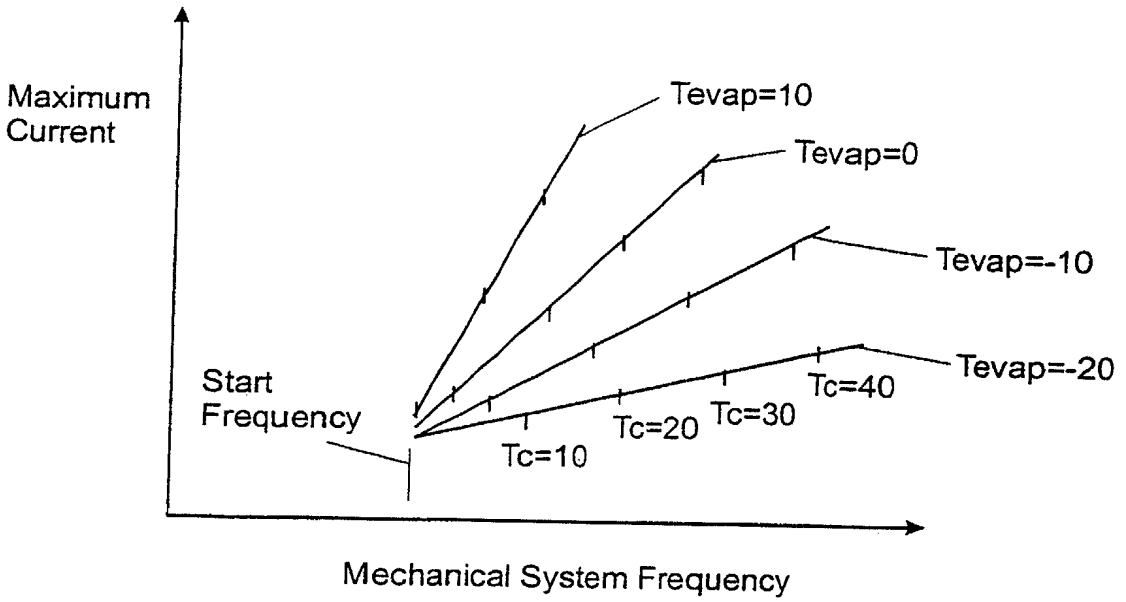

FIGURE 10
Maximum Current as a function of Evaporation Temperature and Frequency

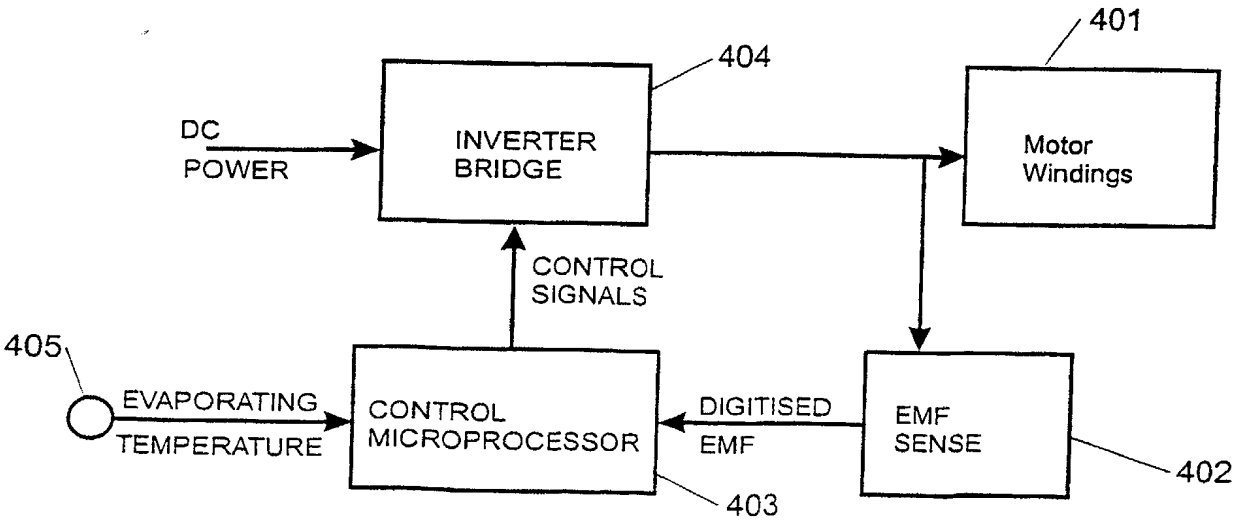

FIGURE 11
Block diagram of the motor control circuit

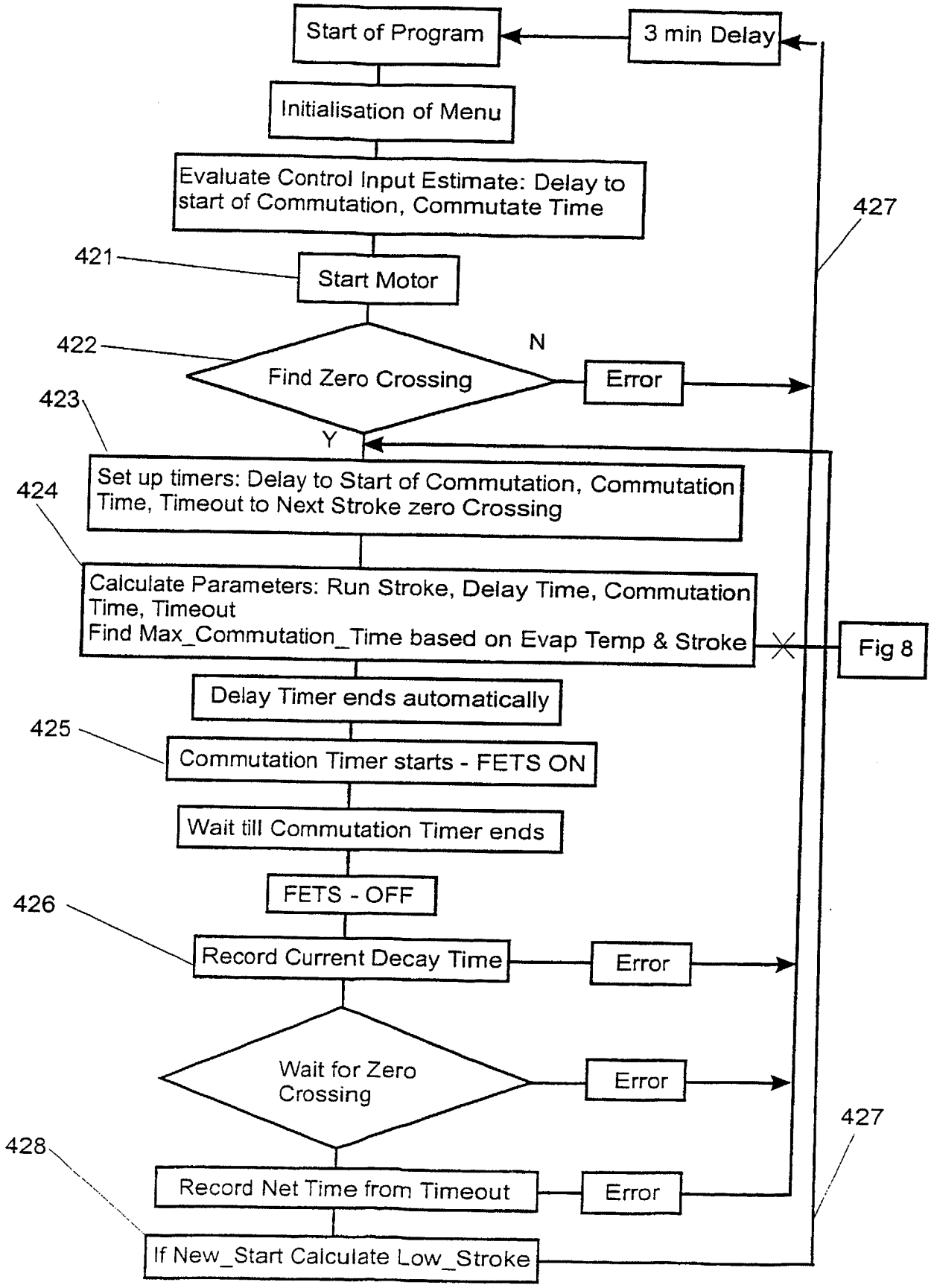

FIGURE 13
Control Microcomputer Motor Control Timing Flow Chart

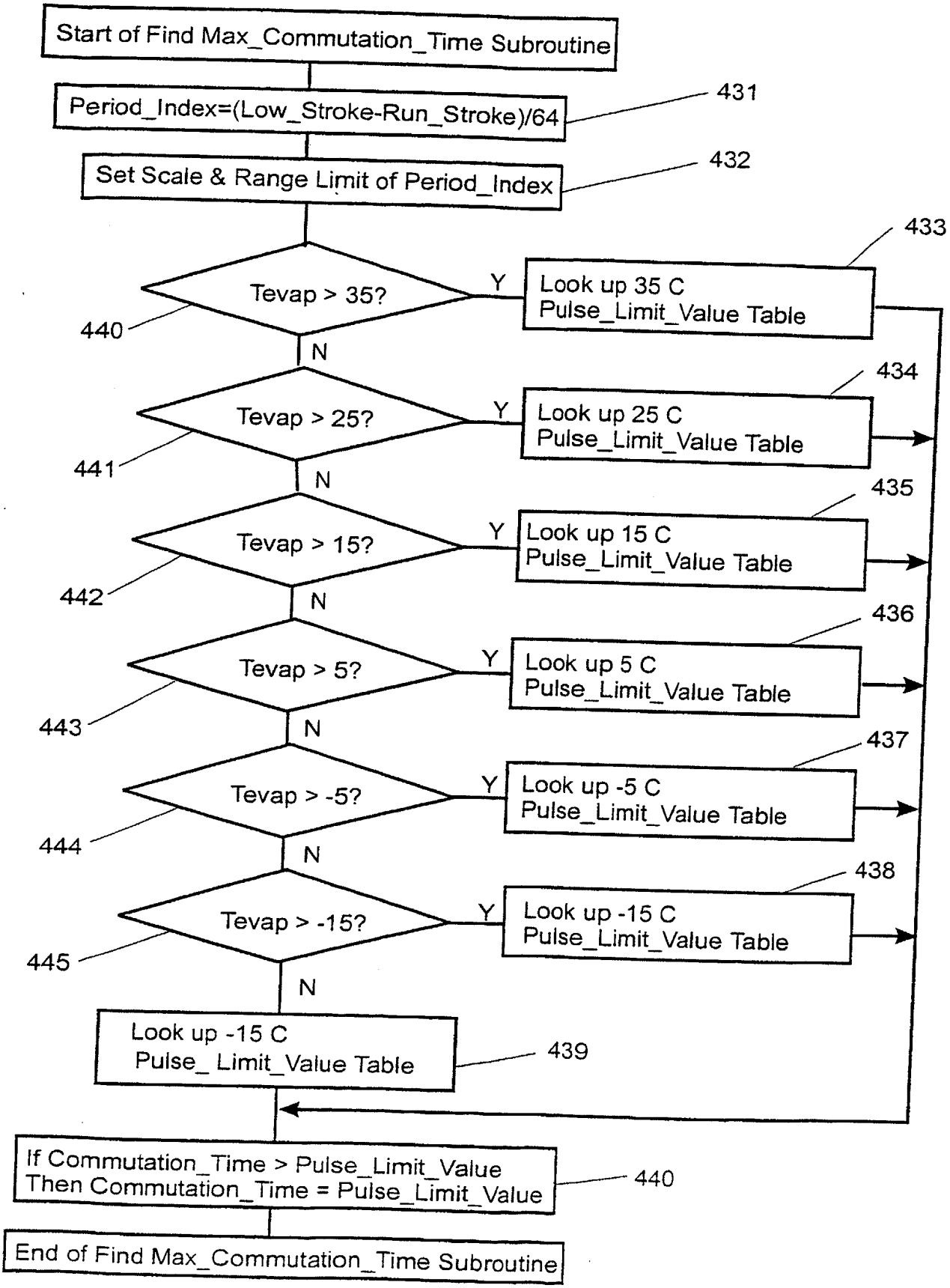

FIGURE 14

Calculation of Commutation Time Limit based on Evap Temp & Stroke Time